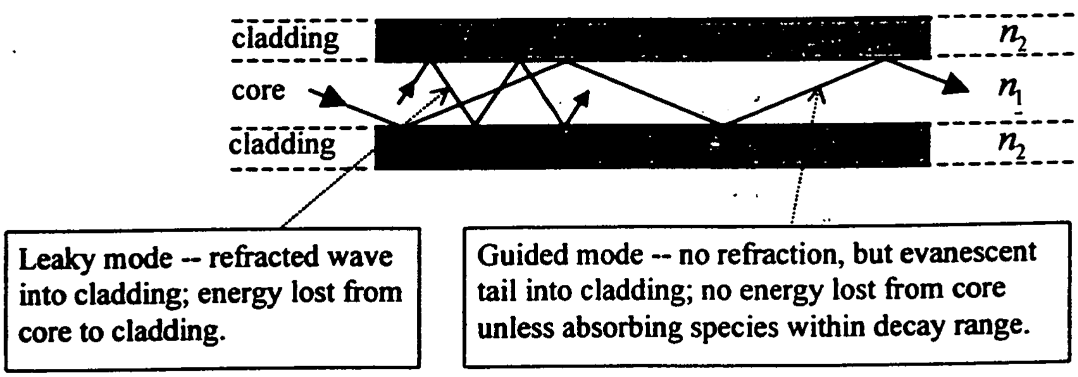


Figure 1: Optical fiber cross-section along the direction of propagation of light.

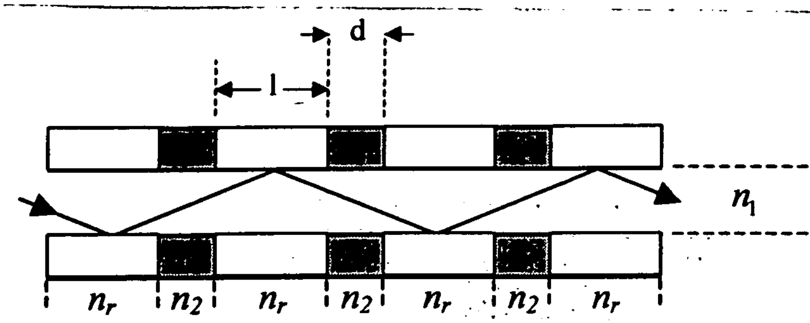


Figure 2: Distribution of reactant regions on fiber. The lightly shaded regions of length l contain the reactants; these regions are separated by a distance d. The index of the original cladding is n_2, while n_r is the refractive index of the substituted cladding that acts as the host for the reactants.

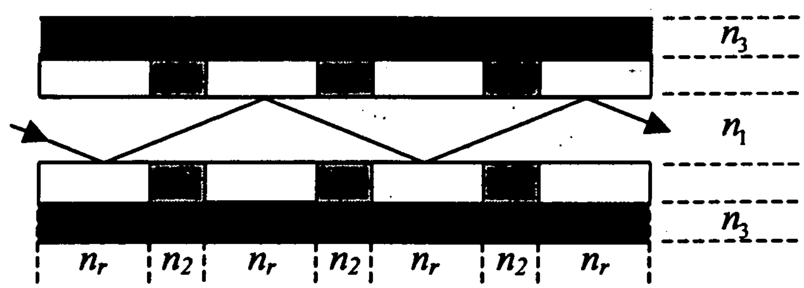


Figure 3: Optical fiber with an additional layer of cladding with refractive index n_3.

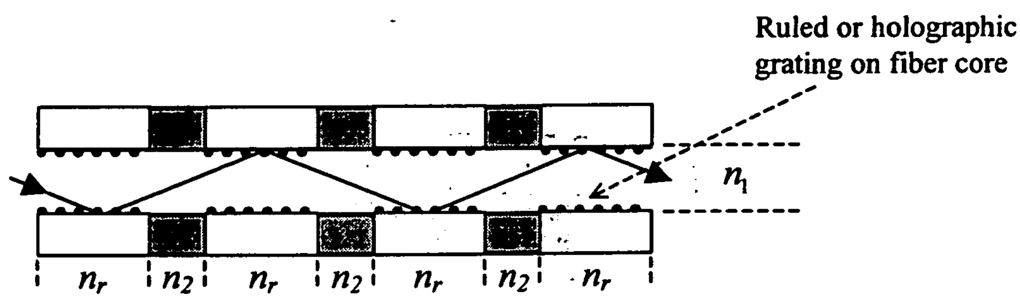


Figure 4: Enhancement of the core-cladding and cladding-core coupling efficiency using a grating at the fiber-cladding interface.

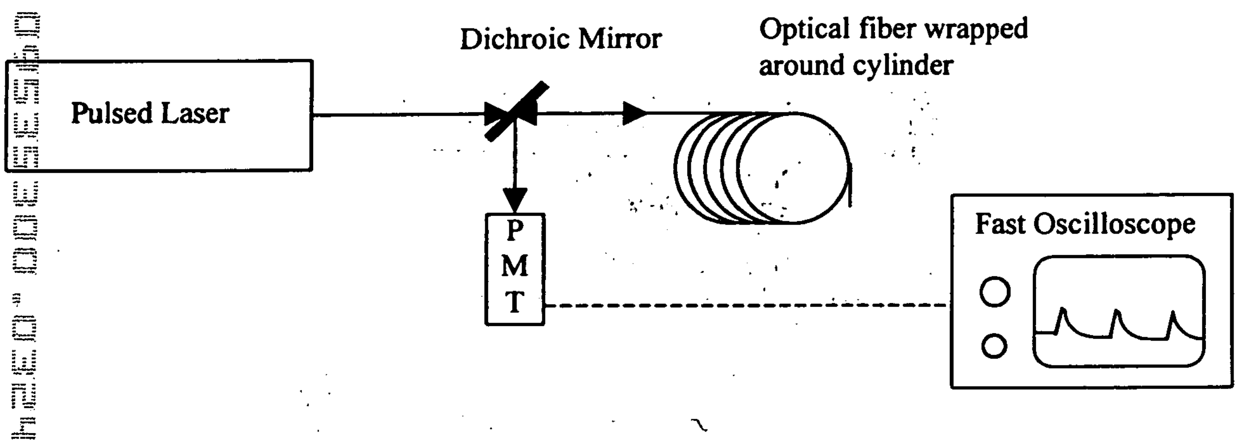


Figure 5: Basic experimental setup: A photomultiplier tube (PMT) connected to a fast oscilloscope records the fluorescent light emitted into the fiber after pulsed laser excitation through the fiber.

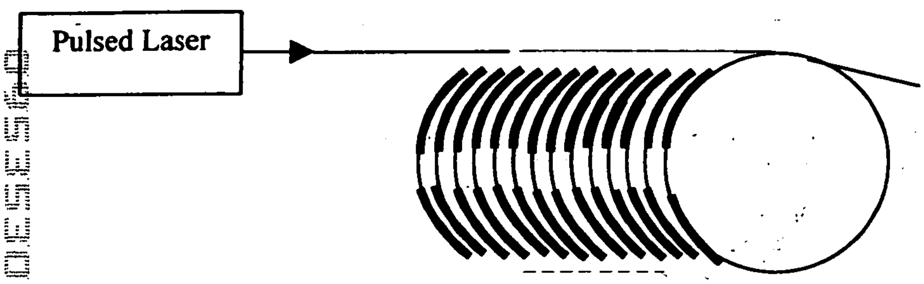


Figure 6: Optical fiber mounted on cylinder. The dark lines represent the reactant regions.

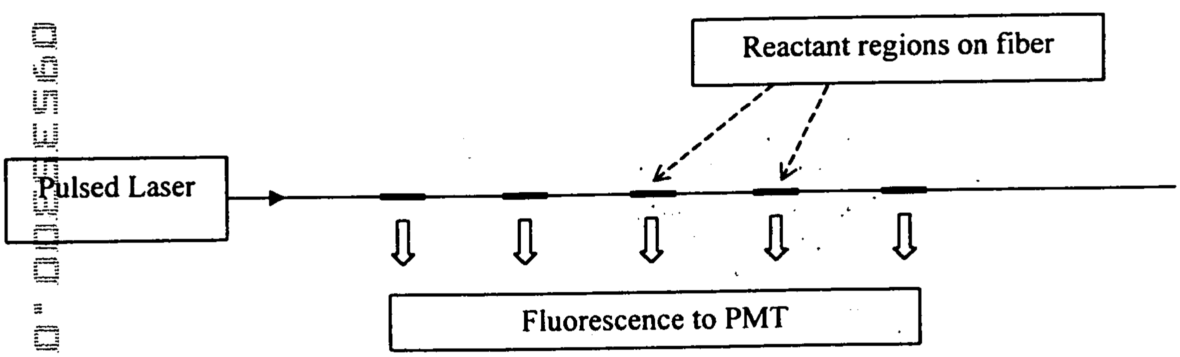


Figure 7: "Sideways" detection of the fluorescence emitted by the reactant regions for a linear fiber.

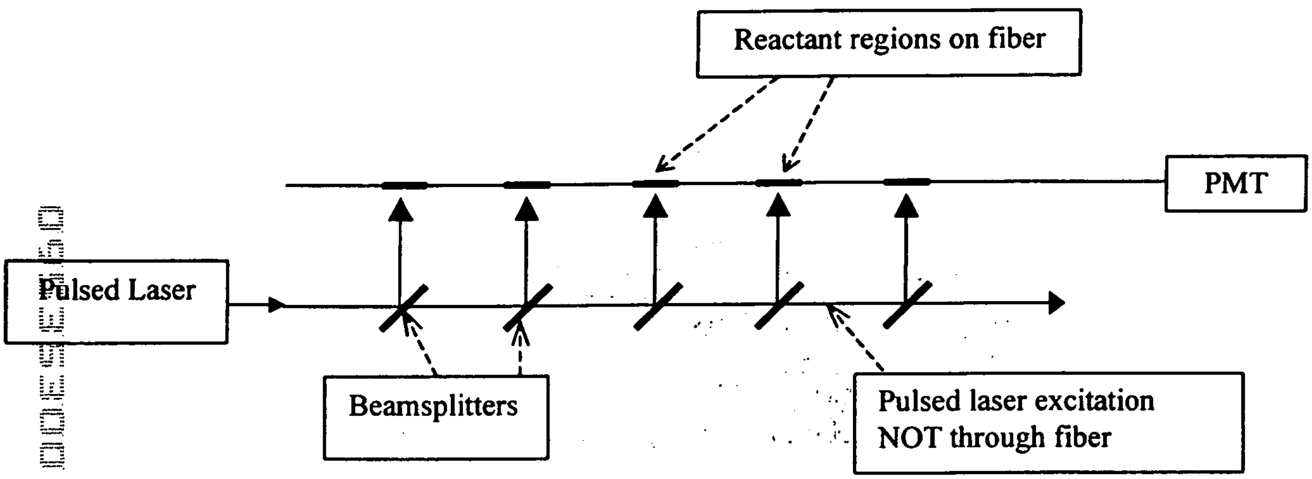


Figure 8: "Sideways" excitation of the reactant regions on the fiber. The fluorescence is picked up by the fiber and guided to the PMT.

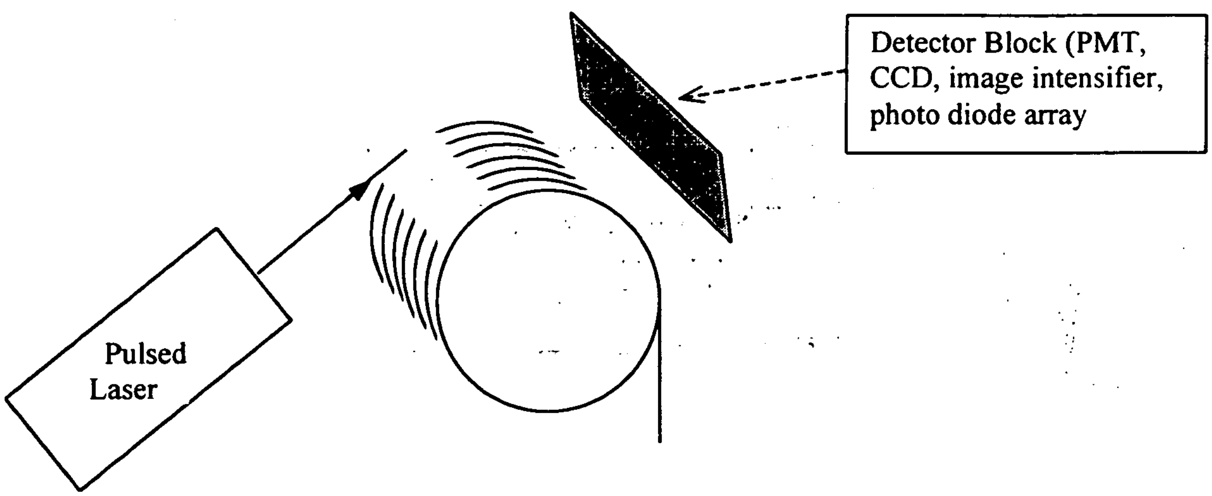


Figure 9: "Sideways" detection scheme for fiber mounted on cylinder. The detector block contains photomultiplier tube(s), charge-coupled devices (CCD's) with/without image intensifiers, or photodiode arrays.

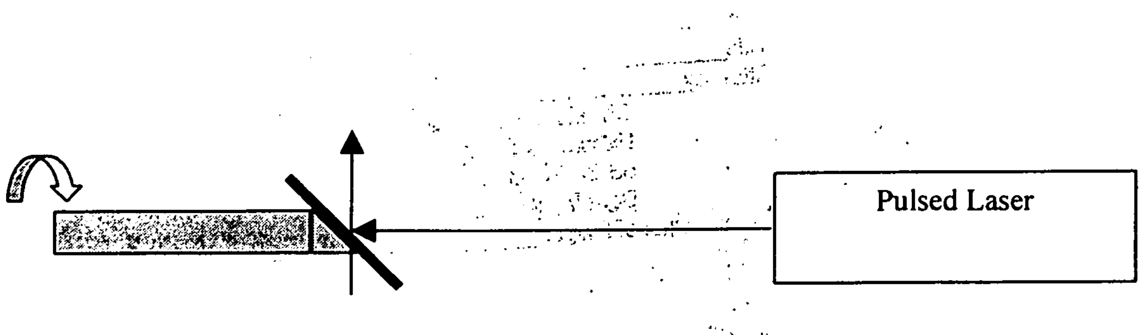


Figure 10: Mirror mounted at 45 degrees on a rotation rod, causing the laser light directed onto the mirror to rotate in space.

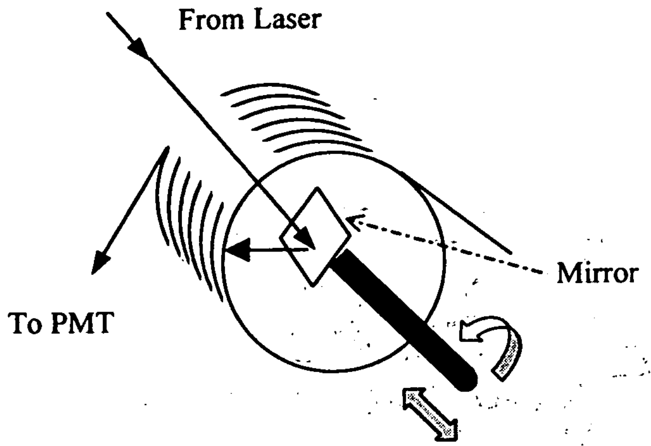


Figure 11: Rotating mirror mounted inside of the cylinder. The laser beam is widened with cylindrical lenses to excite a range of reactant regions.

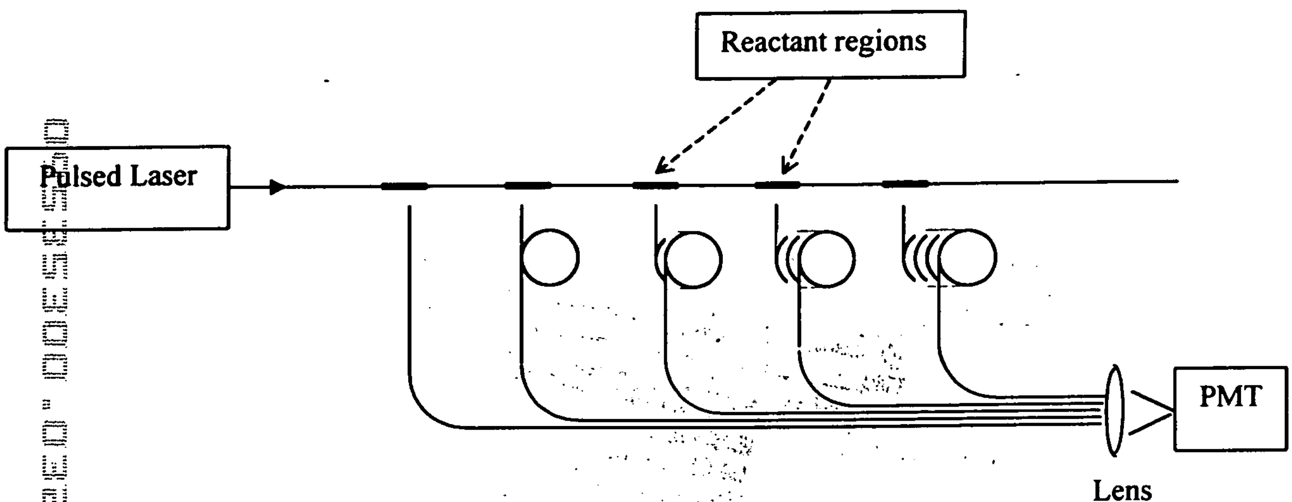


Figure 12: (N+1) fiber scheme: one excitation fiber, which also supports the reactant regions with a detection fiber for each of the N reactant regions. The pickup fibers have different lengths to delay the arrival of the fluorescence signals from different reactant regions at the photomultiplier (PMT).

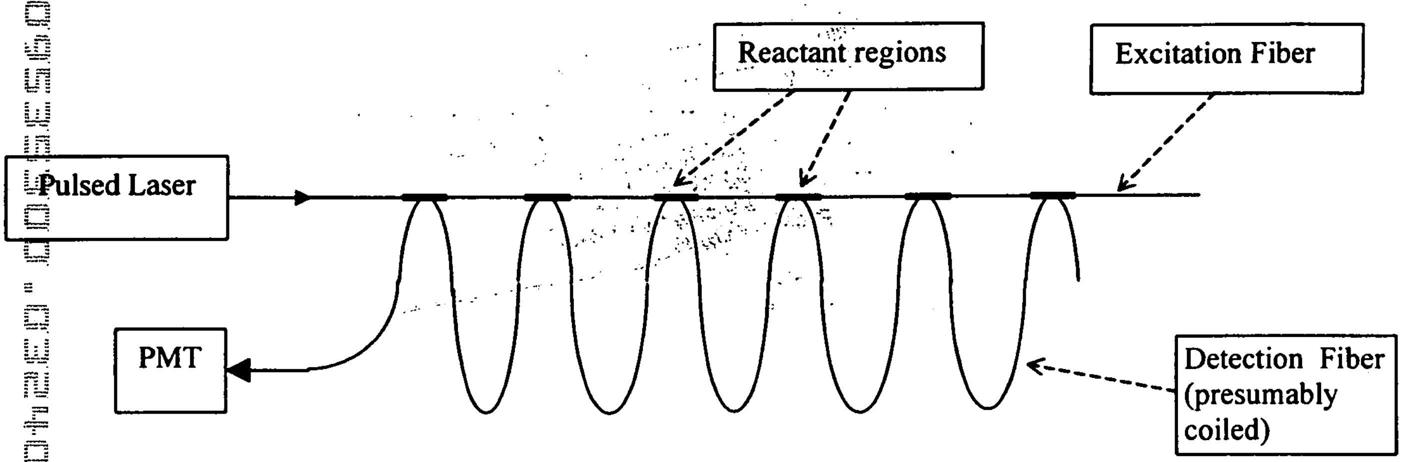


Figure 13: Two-fiber scheme: one excitation fiber containing the reactant regions and one detection fiber that periodically contacts the reactant regions.

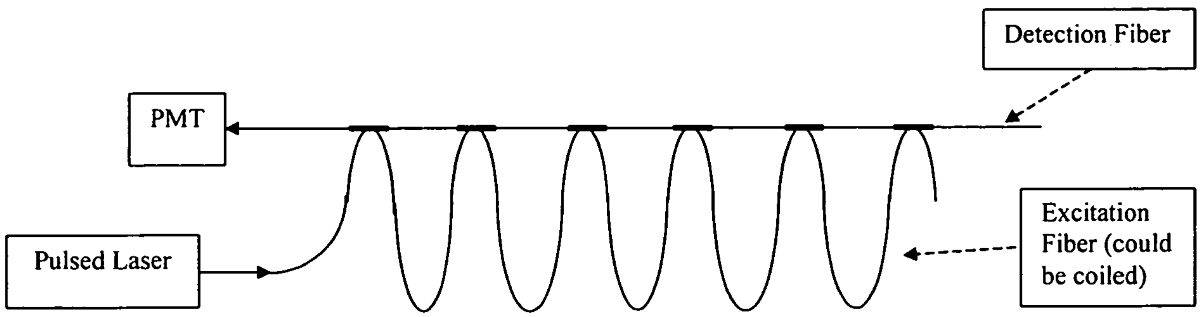


Figure 14: Two-fiber scheme: one detection fiber containing the reactant regions and one excitation fiber that periodically contacts the reactant regions.

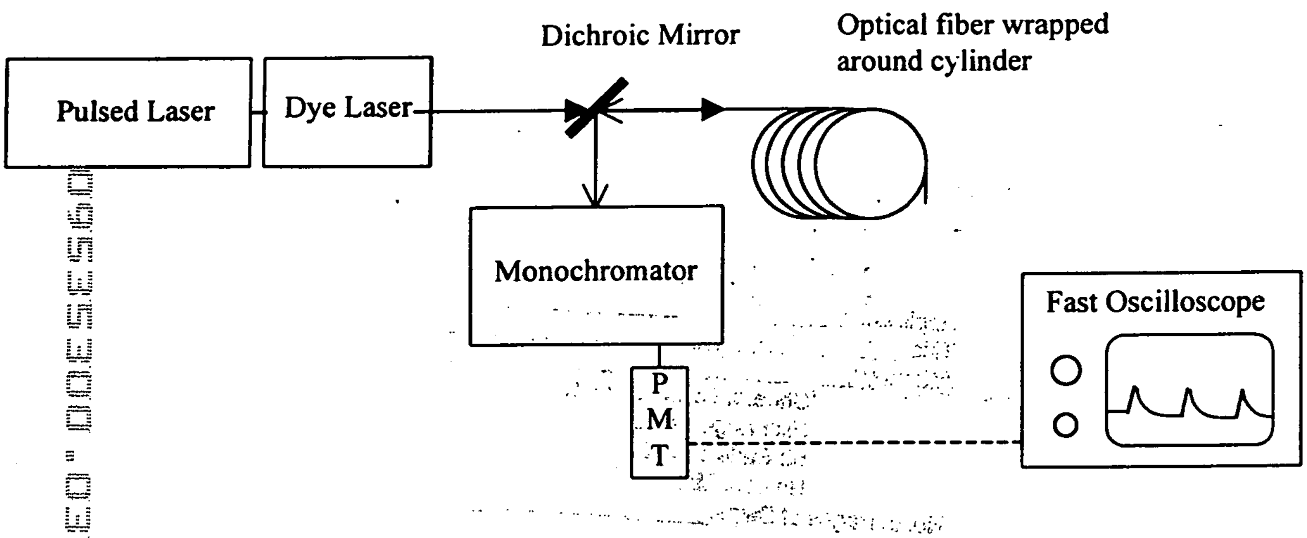


Figure 15: Modified experimental setup (compare with Figure 3): A dye-laser provides variable excitation wavelengths, while a monochromator allows only fluorescence of a specified wavelength region to reach the photomultiplier. Depending on the desired spectral range to be recorded, the monochromator can be replaced with band-pass filters or cutoff filters.

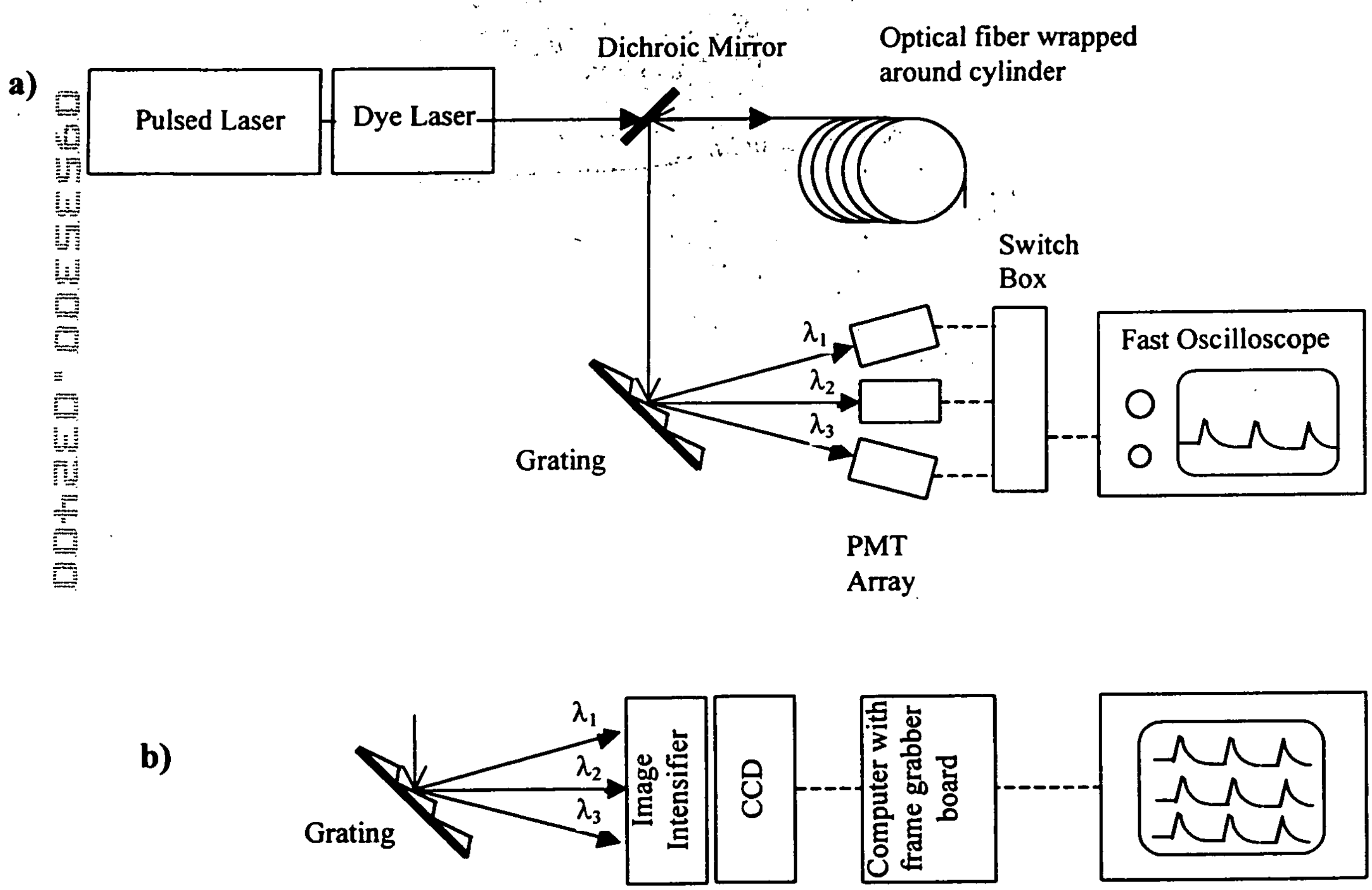
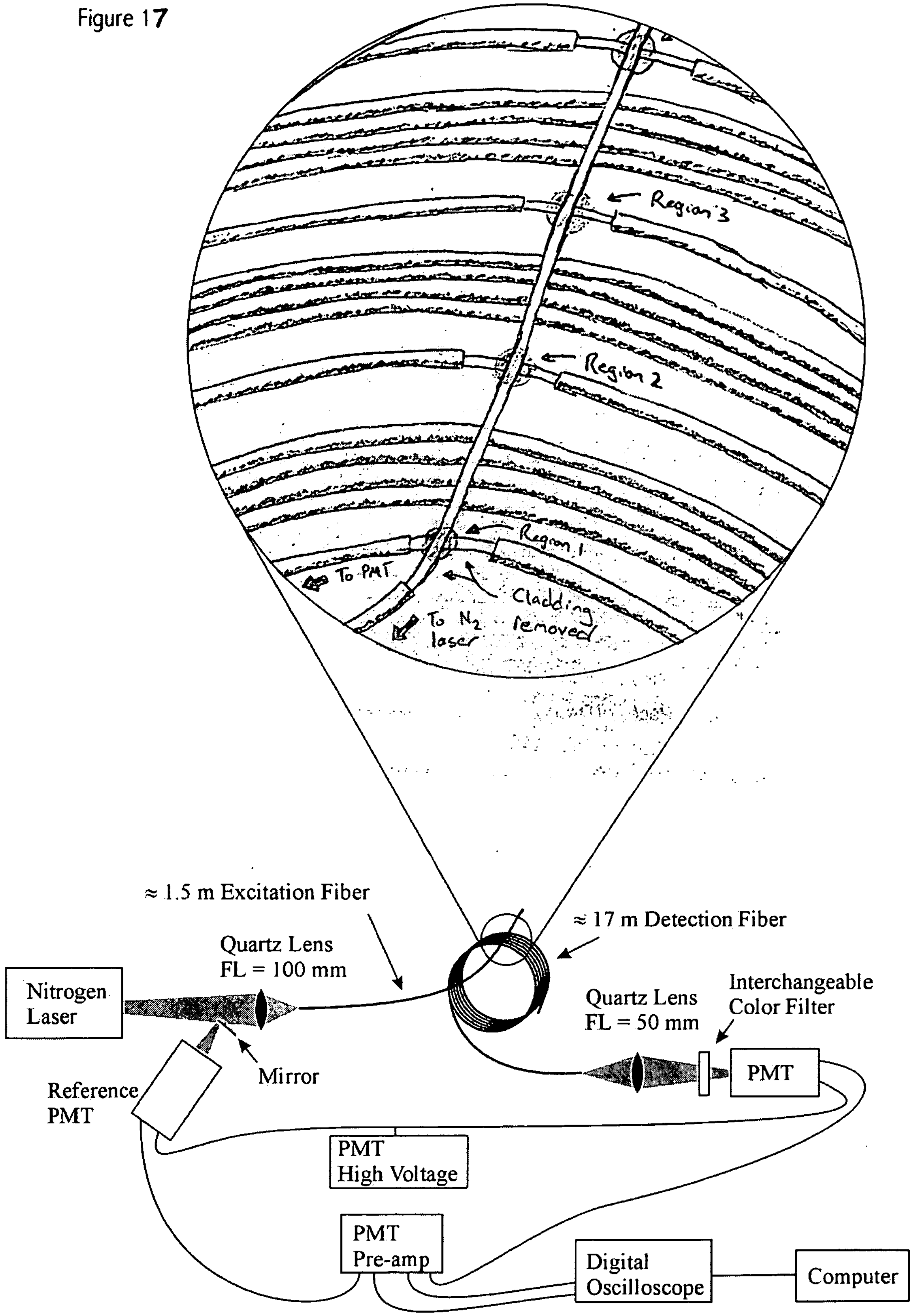


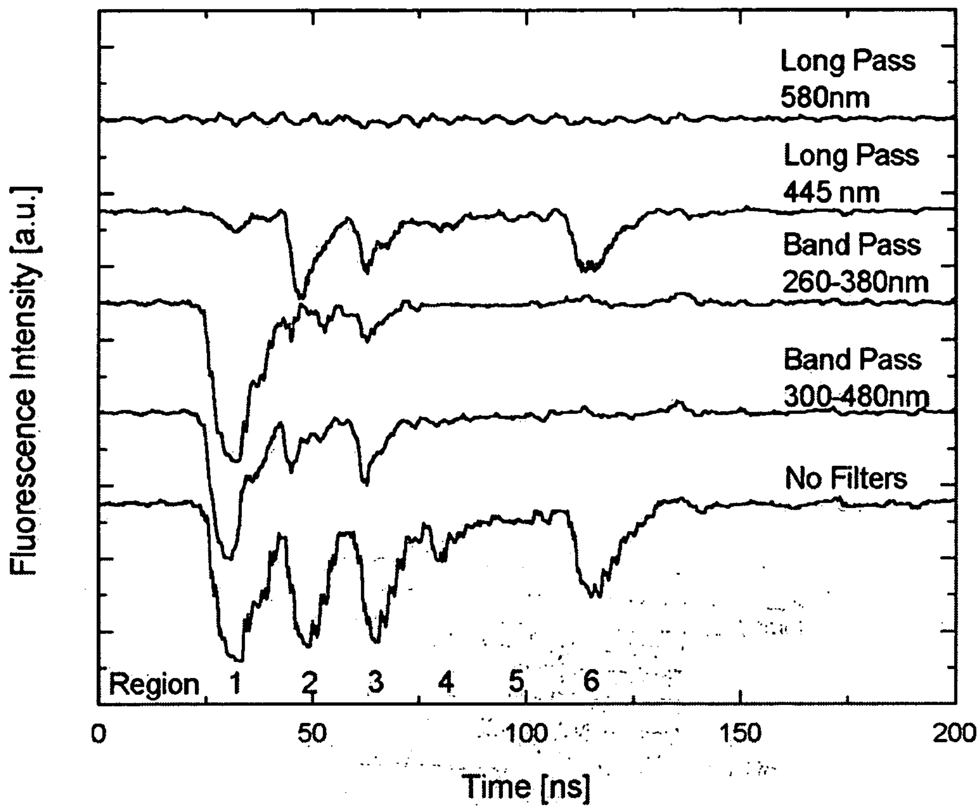
Figure 16: Experimental setup as in Figure 15 but with modified detection scheme. The fluorescence is dispersed according to wavelength by a grating (blazed, if required). For more detail, see text.

Figure 17



Region 3
Region 2
Region 1
To PMT
To N_2 laser
Cladding removed
≈ 1.5 m Excitation Fiber
≈ 17 m Detection Fiber
Quartz Lens
FL = 100 mm
Nitrogen Laser
Mirror
Reference PMT
Quartz Lens
FL = 50 mm
Interchangeable Color Filter
PMT
PMT High Voltage
PMT Pre-amp
Digital Oscilloscope
Computer

Figure 18


Long Pass
580nm
Long Pass
445 nm
Band Pass
260-380nm
Band Pass
300-480nm
No Filters
Fluorescence Intensity [a.u.]
Region 1 2 3 4 5 6
0
50
100
150
200
Time [ns]